VDES - A First Step Improving Arctic's Telecommunications In Future

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Agenda

- Review on communications needs in the Arctic
- Which communications systems exist in the Arctic
- Introduction and overview of VHF Data Exchange System (VDES)

Arctic Communications Users

Some figures
- 4 million population
- 1 million tourists per year
- 4 million passengers passing via airliners
- 1000 persons/year at North Pole

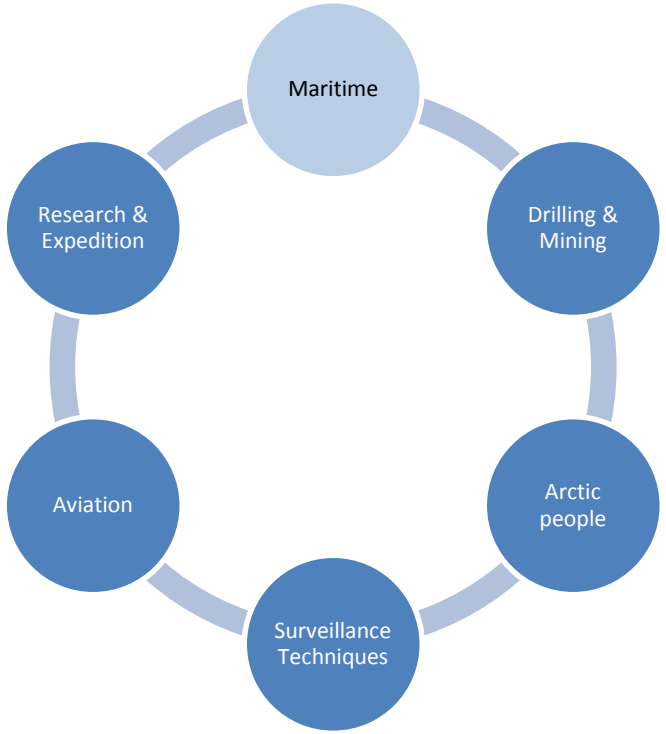
Arctic Communications User Needs

Maritime

Distress and Safety: alternative system to HF communications providing timely distress and safety communication functions above 76°N

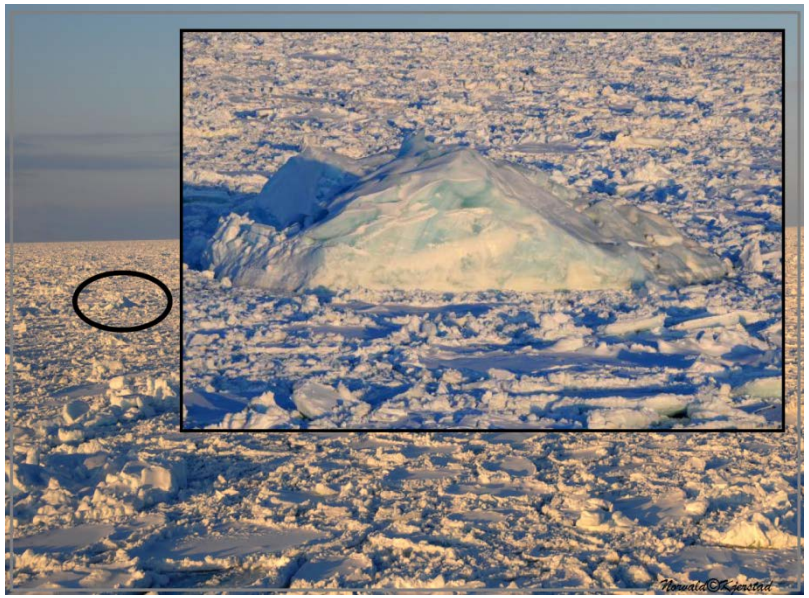
Maritime Safety Information (MSI) service which can be received by ships sailing above 76°N providing ice information

Polar Code (start in 2017)
Two-way voice and/or data communications **ship-to-ship and ship-to-shore** shall be available
Means for **two-way on-scene and SAR coordination** communications
Communication equipment to enable **telemedical** assistance.



User groups:
Fishery, cruises, cargo, coast guard, exploration, expedition, research, leisure, IMO, IALA, etc.

Arctic e-Navigation – yet to be solved

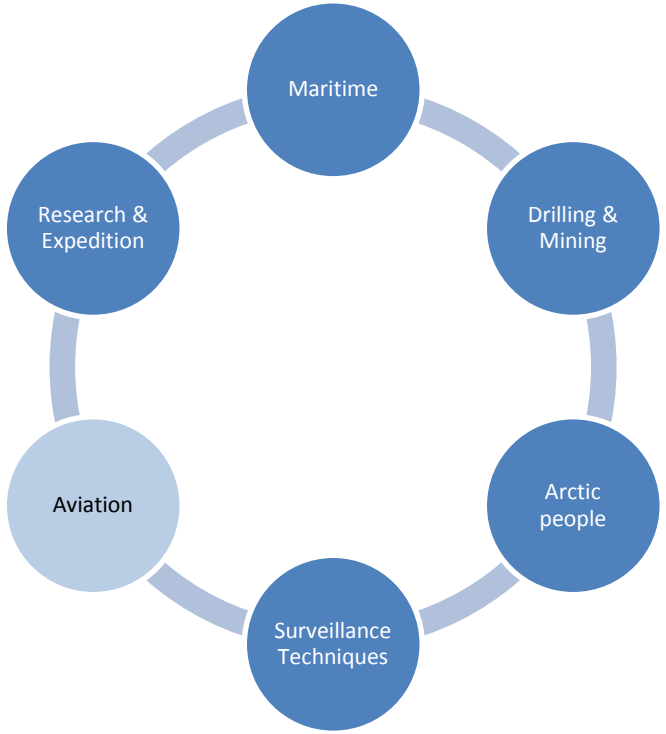


Arctic Communications User Needs

Aviation

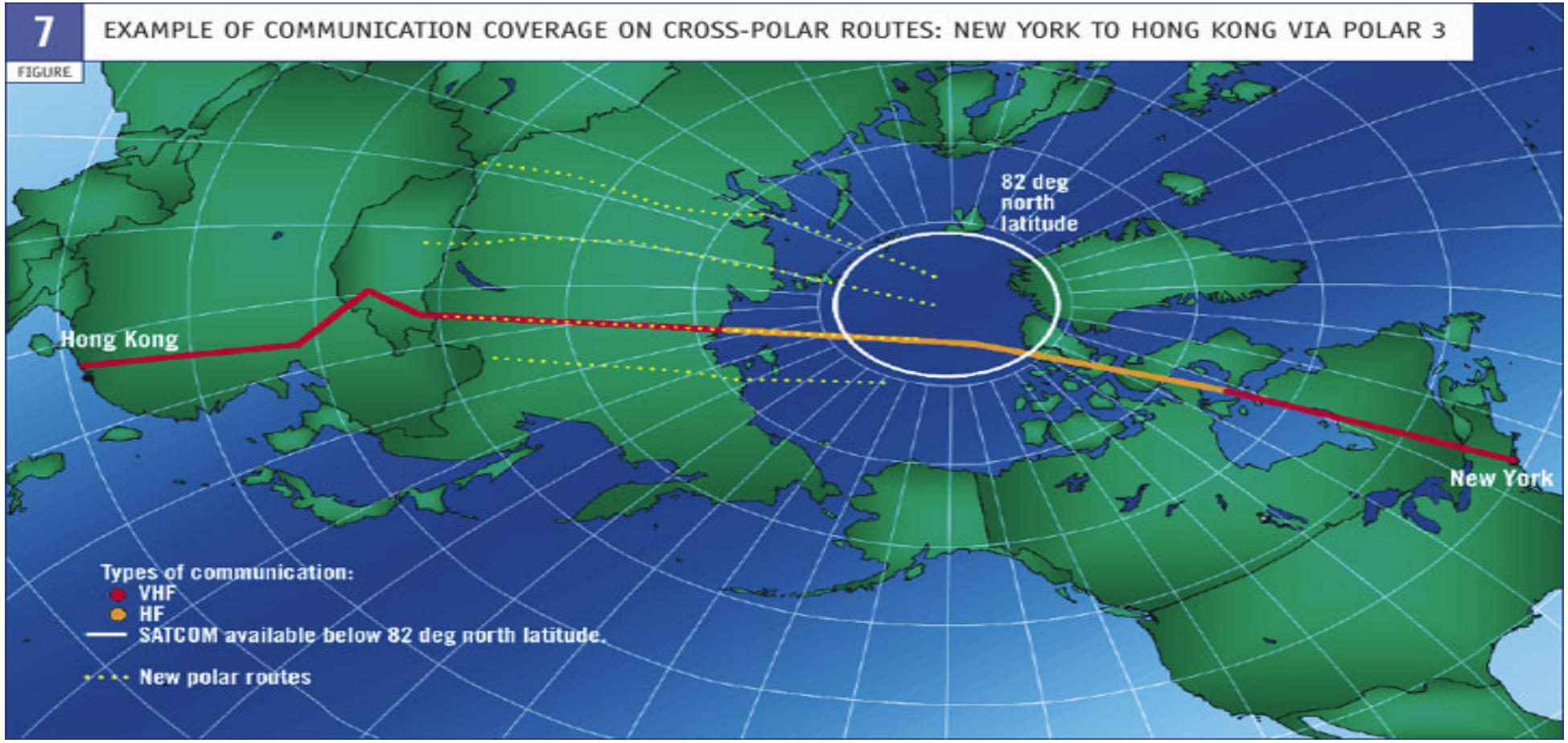
Distress and Safety: alternative system to HF communications providing timely distress and safety communication functions above 76°N

Reliable Navigation:
provided by terrestrial correction signals



User groups:
Air traffic control, airlines, GNSS providers, ICAO

Communications on a polar flight



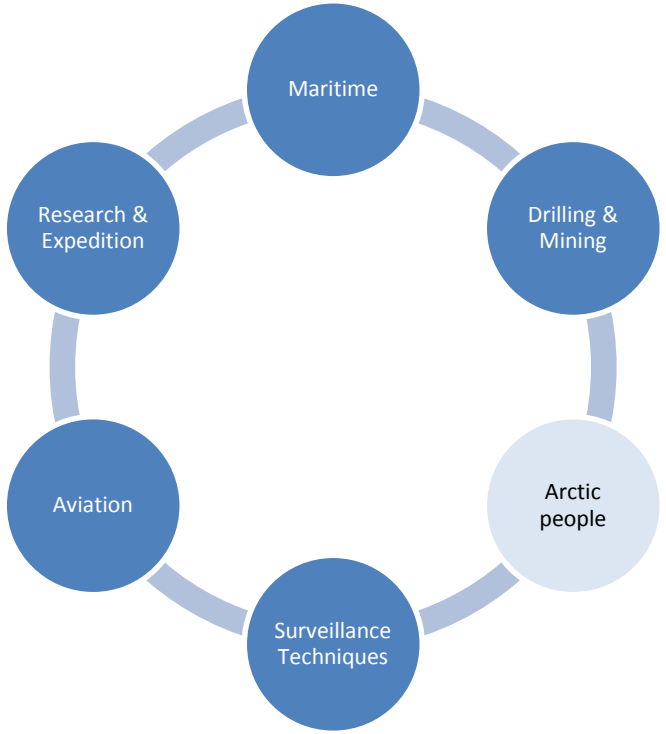
Credits: Aero Magazine 16 by Boeing

Arctic Communications User Needs

Arctic people

Fixed Broadband landlines:
Education, Communication, Telemedical Applications, Entertainment, etc.

Mobile Communication:
provided by terrestrial infrastructure close by the living environment



User groups:
Residents, industry, public authorities, service provider

Arctic Communications User Needs

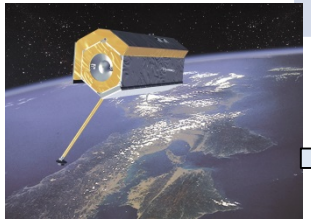
Surveillance Techniques

Situation Awareness:
Maritime Situation for all users (ice, iceberg, etc.)

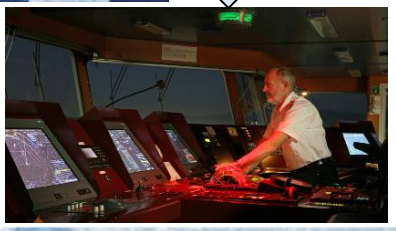
Administrative Bodies:
illegal fishery, oil spills, security, illegal activities, safety

Situation awareness
=
Safety

User groups:
Coast guards, administrative bodies, IMO, fishery, ship owner, drilling, etc.





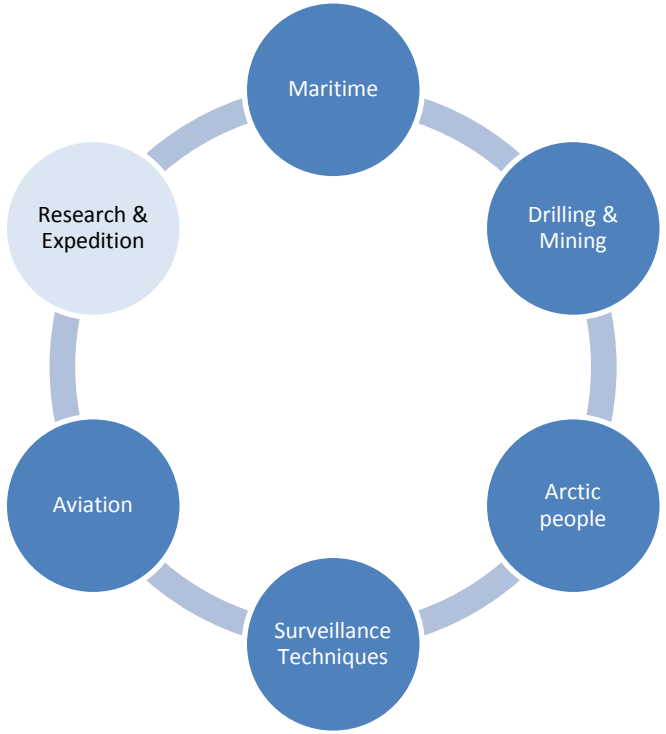
Credits: DLR, sjofartsverket.se, freefoto.com

Arctic Communications User Needs

Research & Expedition

Distress and Safety: alternative system to HF communications providing timely distress and safety communication functions above 76°N

Cost efficiency:
alternative terrestrial systems for long range communications instead of high cost satellite systems



User groups:
Researchers, expeditions, research stations, sensors / autonomous platforms, etc.

Demands on data throughput for different applications

	Applications	Demand on data throughput
Maritime	Emergency messaging; Mandatory reporting; Operation and navigation reporting	Low (<10 kbit/s)
	Technical maintenance	Low (<50 kbit/s)
	Training and qualification; Safety and technical monitoring, telemedical application	Medium (<1 Mbit/s)
	Infotainment; Crew welfare	High (<10 Mbit/s)
	Special purpose applications (oil exploration, unmanned demanding, video conferencing, offshore operations…)	High (<20 Mbit/s)
Aeronautical	Air traffic control (minimal demand) (scheduled and nonscheduled flights, helicopter…)	Low (<10 kbit/s)
	Infotainment	High (<10 Mbit/s)

Summary of main needs

- Robust and reliable voice communication for maritime and aeronautics (safety)
- Providing data links for surveillance data distribution
- Requirements of Polar Code (starting in 2017) has to be fulfilled -> telemedicine (~300-500kbps)
- Increase of fixed fiber landlines (backbone via submarine cables)
- Low cost communications for research applications (e.g. sensor data)

Current communications coverage limitations

	System	Characteristics	Polar (> 80°N)	Sub-polar (70°N - 80°N)
Terrestrial systems	HF (500 kHz)	NAVTEX (safety related messages)	Unsuitable for digital communications (<0.1 kbps)	
	HF (500 kHz)	NAVDAT (safety related messages)	Currently unavailable; NAVTEX architecture for narrowband data (10-20 kbps)	
	HF, MF	Safety related messages and voice only	Unsuitable for digital communications	Unsuitable for digital communications
	VHF, Digital VHF	Line-of-sight voice and narrowband data	No base stations	Few base stations
	GSM, 3G	Line-of-sight voice and narrowband data	No base stations	Very few base stations
	LTE/4G, WiMAX	Line-of-sight voice and broadband data	No base stations	Insignificant deployment
SatCom systems	GEO (Inmarsat, VSAT)	Medium capacity - low to moderate latency	Unavailable	Limited availability and quality
	LEO (Iridium)	Narrowband data communications – high and variable latency	Potential problems with capability/ quality	Potential problems with capability/quality
	HEO	Properties comparable with GEO	Currently unavailable, but expected to provide good coverage and properties comparable to GEO systems at lower altitudes (< 60°N).	

Comment: Satellite at aircraft is generally not available above 82°N.

Existing and planned Arctic civil communications satellite systems

	Inmarsat	Iridium	Cospas-Sarsat	Globalstar	Gonets-D1M
Orbit	GEO	LEO	LEO	LEO	LEO
Arctic coverage	Max. up to 81°N	Total	Total	Max. up to 80°N	Almost total
Status	Existing	Existing	Existing	Existing	Existing
Capabilities	450 kbit/s	9.6 kbit/s (max. 130 kbit/s)	Distress messaging	9.6 kbit/s	64 kbit/s

	Iridium NEXT	Arktika	PCW	ARGOS-4	visions
Orbit	LEO	HEO	HEO	LEO	HEO
Arctic coverage	Total	Russian sector	North American sector	Total	European sector
Status	Operational in 2017	Planned launch in 2017	Planned launch in 2016 (delayed)	Planned launch in 2016	Envisioned launch in 2020
Capabilities	1.5 Mbps	Observation, meteorology, communications	Meteorology, communications	Observation, minor communi-cations	Communi-cations

A new system – VHF Data Exchange System (VDES)

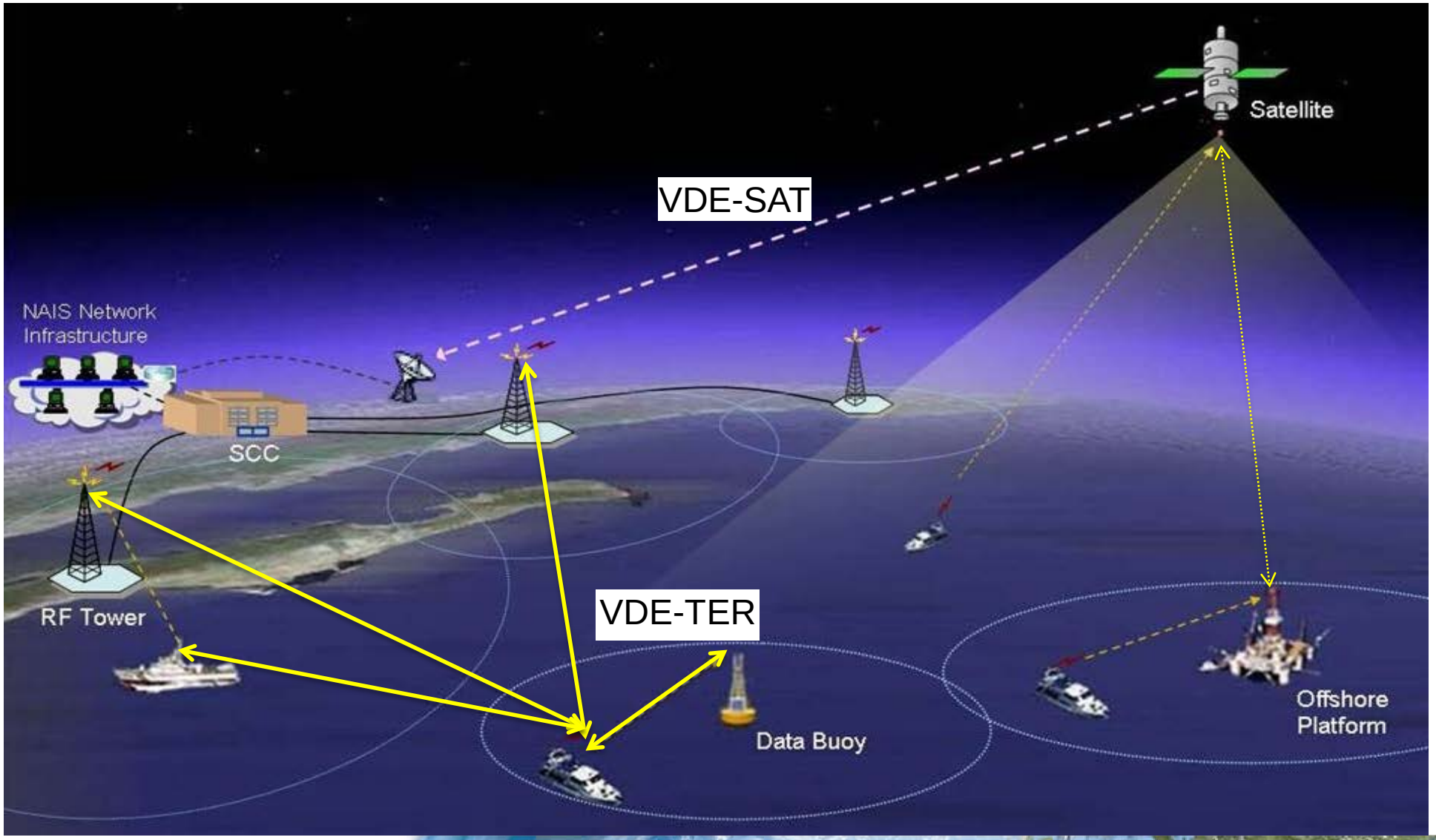
- New potential digital VHF terrestrial and satellite services are envisioned and are currently in a standardization process. (-> IALA, ITU)

- Driven by the modernization of the global maritime distress safety system (GMDSS) and IMO's maritime e-Navigation strategy:
  - Terrestrial VDES frequencies are approved by World Radio Conference (WRC 15)
  - Request for new satellite VHF spectrum allocations towards WRC 19

- The initial approaches are looking at a system with possible data rates of about

  75kbit/s by 25kHz; **150kbit/s** by 50kHz; and **300kbit/s** by 100kHz bandwidth usage

- Furthermore, broadcasting services for the satellite-to-ship links are envisioned and can be particularly important for safety related information (e.g., ice maps)


Satellite
VDE-SAT
NAIS Network
Infrastructure
SCC
RF Tower
VDE-TER
Data Buoy
Offshore
Platform

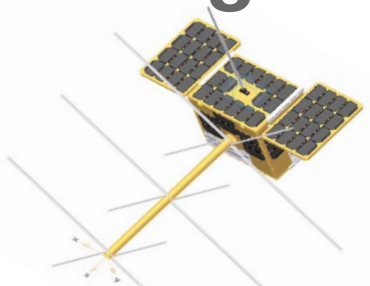
Technical Challenges for terrestrial VDES

- Signal design:
    - Handling the usage of frequency spectrum in conjunction with the satellite VDES signals in same spectrum
        - How to handle this inference
        - How to minimize interference towards the satellite system and vice versa
    - Convincing the maritime communication system manufactures towards already proven robust digital transmission schemes (e.g. from the mobile phone community (4G or 5G))
- System architecture
    - Handling national system vs. global architecture

2-way VHF Data Exchange satellite system testing

SPACE NORWAY

VHF



1 Mbps up/down
S-band

Norsat-2 (Test satellite, **launch Q4/2016-Q1/2017**)
- 600 km orbit
- 98 minutes period
- 20 minutes Arctic coverage
- Two way store and forward data transfer

OPS center

Vardø Gateway
70,4 N

IMO eNav service portfolio
- VTS Information Service (IS)
- Navigational Assistance Service (NAS)
- Traffic Organization Service (TOS)
- Local Port Service (LPS)
- Maritime Safety Information Service (MSI)
- Pilotage Service
- Tugs Service
- Vessel Shore Reporting
- Telemedicine Assistance Service (TMAS)

- Maritime Assistance Service (MAS)
- Nautical Chart Service
- Nautical Publications Service
- Ice Navigation Service
- Meteorological information Service
- Real time Hydrographic and Environmental info Service
- Search and Rescue Service (SAR)

Internet

Third party applications
Public communications

Credits: Information and pictures are by Space Norway

DLR

Summary

- There is an increasing need of reliable and robust digital communication in the Arctic regions
- Current communications system cannot sufficiently provide the needed data communication
- One step towards closing this gap is the introduction of the new terrestrial and satellite-based VHF Data Exchange System (VDES)
- Optimistic road maps envision first commercial VDES equipment in 2020